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The Study of Management Information System for Coal Mine Safety Quality Standardization

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Abstract

In coal mine safety management, quality management and safety management supplement each other. Paying attention to quality characteristics of safety aspects is very important to coal mining enterprises, which can avoid and prevent coal mine safety problems. By the analysis of the coal quality and safety circumstances, system modules are designed. Fuzzy integrated evaluation is introduced. By evaluating the safety quality standardization of coal mine, it gets safety level. Finally, coal mine safety quality standardization management information system is developed by Visual Basic software.

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Keywords: Coal mine safety; Quality standardization management information system; Fuzzy integrated evaluation; Visual Basic

1. Introduction

With the sustainable developement of China's economy, higher request is put forward on coal mine safety. However, coal mining's overall production level, technological progress and management in China have a great gap with the international advanced level. Safety accidents occur frequently, and bring heavy losses to national economy and people's life and property. According to experience of the domestic and international coal mine safety management, coal mining enterprises use information technology to improve safety management level, and establish coal mine safety quality standardization management information system, which has disaster prevention, standardization evaluation, and electronic information management.

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In most of the important state-owned coal mine enterprises, information systems of finance, scheduling, statistics, equipment, and sales application are more common. They get better benefits. But in coal mine safety management it is slow. In order to solve this problem, this paper studies and develops the coal mine safety quality standardization management information system to enhance the success rate of coal mine safety quality standardization management and promote coal mine safety management efficiency.

2. Design system module

In order to realize the development of the system software, firstly, analyze requirements in practical work, then divide system module, finally design system software. The demand of the coal mine safety quality standardization management information system expresses the following aspects:

1) Inquire system: The system can easily inquire, retrieve and show regulations of coal mine quality standardization and coal mine safety.

2) Personnel management: Hunman are the first elements in security. Behavior-based safety is the most important in the safety management. This system can check and manage the information of managers and employees.

3) Training management: Coal mine managers and workers learn coal mine safety quality standardization, and the effect of their learning must be assessed. It makes the concept of quality standardization system deep into everybody's mind, and they implant the concept into work.

4) Evaluation of quality standardization: It evaluates quality management standardization in coal mines. Fuzzy integrated evaluation is used. The system shows the scores of coal mine quality standardization. This function is the most important in system design.

5) Equipment management: Safety equipment is in a dynamic management environment. It provides real-time monitoring to all equipment and coal mine safety working site.

6) Rewards and punishments management: It can conveniently input and inquire each quality standardization and assessment results, standings, and award list. It can provide effective information for decision-making departments and employees.

7) System management: Coal mine safe quality standardization management information system should have a safe systematic management function. All levels and angles such as data storage, retrieval, extraction, release and management must have the corresponding security guarantees. System chooses the current mature data encryption technology to ensure data security.

According to the above analysis, coal mine safety quality standardization management information system can be divided into quality standardization inquires management module, worker information management module, safety training management module, safety quality standardization evaluation management module, safety equipment management module, safety rewards and punishments management module, system management module, which is shown in Fig.1.

Fig.1.Coal Mine Safety Quality Standardization Management Information System Composition

3. Model selection

In coal mine safety quality standardization management information system, quality standardization evaluation management module is the most important. According to the standard of coal mine safety quality standardization and assessment rating method, it is very important to select model in quality standardization evaluation. Fuzzy integrated evaluation can comprehensively evaluate objects affected by many kinds of factors. Its characteristic is that its results is not absolutely true or false, but it uses a fuzzy set to explain.

This system evaluation index is multi-objectives and multi-level, so multi-objectives and multi-level fuzzy integrated evaluation is selected to evaluate system. Quality standardization evaluation factors are shown in Fig.2.

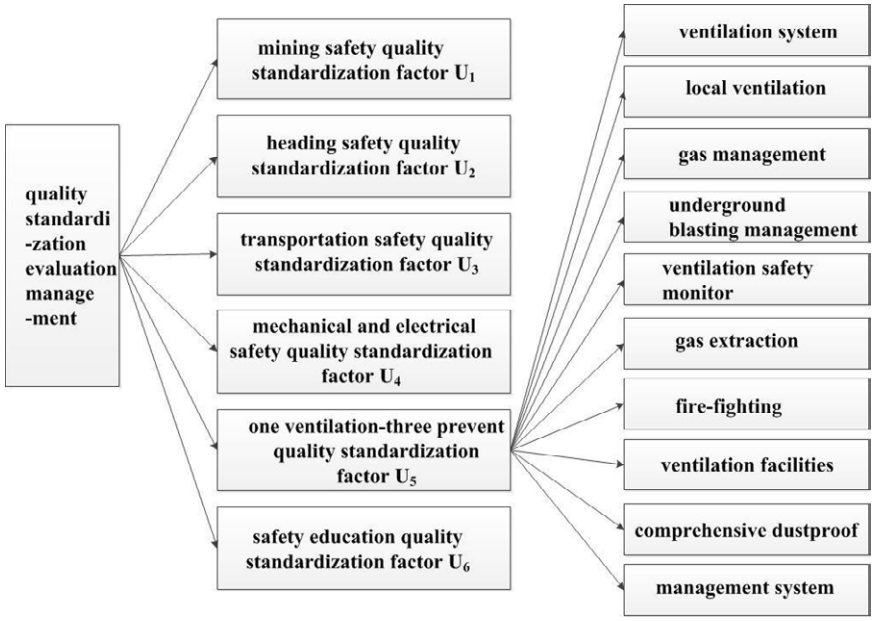

Fig.2. Analysis of Quality Standardization Evaluation Factors

Step 1: giving destination layer -coal mine safety quality standardization factors set U.

Dividing U into n subsets: U_1, U_2, …, U_n, which respectively represent mining safety quality standardization factor, heading safety quality standardization factor, transportation safety quality standardization factor, mechanical and electrical safety quality standardization factor, one ventilation-three prevent quality standardization factor, safety education quality standardization factor. They should meet the following conditions：

$$\bigcup_{i=1}^{n} U_i = U \tag{1}$$

$$U_i \bigcap U_j = \varnothing \qquad i \neq j \tag{2}$$

U_i contains m sub-index, $U_i=\{U_{i1},U_{i2},\ldots,U_{im}\}$ i=1,2,…,m. These sub-indexes stand for the results of subdividing the safety quality standardization factors. Sub-evaluation is mainly from person, material, machine and environment.

Step 2: Establish weight set w of destination layer. W is obtained based on the coal mining enterprises standardized rating manual or expert evaluation.

$$W = (w_1, w_2, ..., w_n)$$

$$\sum_{i=1}^{n} w_n = 1 \tag{3}$$

Suppose U_{ij} is the sub-index of safety quality standardization factor U_i. Its weight coefficient is w_{ij}, i=1,2,…,n; j= 1,2,…,m. The n_{th} sub-index weight set of i_{th} class factor is:

$$w_i = (w_{i1}, w_{i2}, ..., w_{in}) \quad (i = 1, 2, ..., n) \tag{4}$$

Step 3: Establish alternative classification sets. It is expressed with $v=(v_1,v_2,\ldots v_m)$. The result of evaluation generally use the excellent, good, medium and poor or security, less safe, dangerous and very dangerous to express. According to actual conditions, we develop reasonable safety evaluation criteria in a coal mine safety quality standardization evaluation.

Step 4: Level 1 Fuzzy integrated evaluation. For example, one ventilation-three prevent quality standardization factor can be divided into ten subsidiary indexes: a. ventilation system, b. local ventilation, c. gas management, d. underground blasting management, e. ventilation safety monitoring, f. gas extraction, g. fire-fighting, h. ventilation facilities, i. comprehensive dustproof, j. management system, which is shown in Fig.2. Giving integrated evaluation of each kind of sub-index factors, according to sub-index U_{ij}. According to membership function values r_{ij}(i=1,2,…,m;j=1,2,…,n) of each sub-index U_{ij}, obtain the single index for judgment matrix:

$$R_i = \begin{bmatrix} r_{i1} \\ r_{i2} \\ \cdots \\ r_{im} \end{bmatrix} \tag{5}$$

The evaluation of one ventilation-three prevent quality standardization factor U_i uses the following formula to calculate:

$$B_i = r_i \times w_i = \{b\} \quad (i=1, 2, \cdots, n) \tag{6}$$

Get results B_i, and it is one ventilation-three prevent quality standardization factor assessment results. It is also level 1 fuzzy integrated evaluation results.

Step 5: Level 2 Fuzzy integrated evaluation.

Level 1 integrated evaluation is only for each destination layer in each sub-index of evaluation. Fuzzy integrated evaluation needs to consider the influence of various destination layer index. This requires integrated evaluation of each destination layer. Evaluate U_1, U_2, ..., U_n again. This is Level 2 Fuzzy integrated evaluation. Destination layer judgment matrix is level 1 evaluation result. Level 1 evaluation results constitute a matrix. It is R:

$$R = \begin{bmatrix} B_1 \\ B_2 \\ \cdots \\ B_m \end{bmatrix} \tag{7}$$

If the weight of each destination layer is w, the Level 2 fuzzy integrated evaluation results are expressed with D:

$$D = W \times R = \{d\} \tag{8}$$

Step 6: After obtaining the result of evaluation, a suitable level standard is found out in coal mine evaluation of quality standardization. Quality standardization safety level is finished. The work of evaluation is end.

4. The Selection and Application of Programming Language

Since the 1990s, Client/Server (C/S) calculation structure has been developing quickly. C/S structure concentrates the advantages of the server and personal computes. It has power to store and process large number of data as mainframes, and also has the interaction skills with users as PC. C/S structure falls into two aspects in data processing: the server and client computers. The system development tools of C/S structure have Delphi, Visual Basic, Power Builder, etc.

The biggest advantage of Visual Basic lies in its ease-of-use and it can quickly develop procedures, besides, software development cost is low. Secondly, VB program connects database simply. For example, using controls can bind database, and thus programs written by VB can master all the information of the database without writing code of a single line. Thirdly, human-computer interaction interface is friendly and easily operate of the software developed by VB. To sum up, using Visual Basic to develop coal mine safe quality standardization management information system is suitable. Using VB program, system module processes are shown in Fig.3.

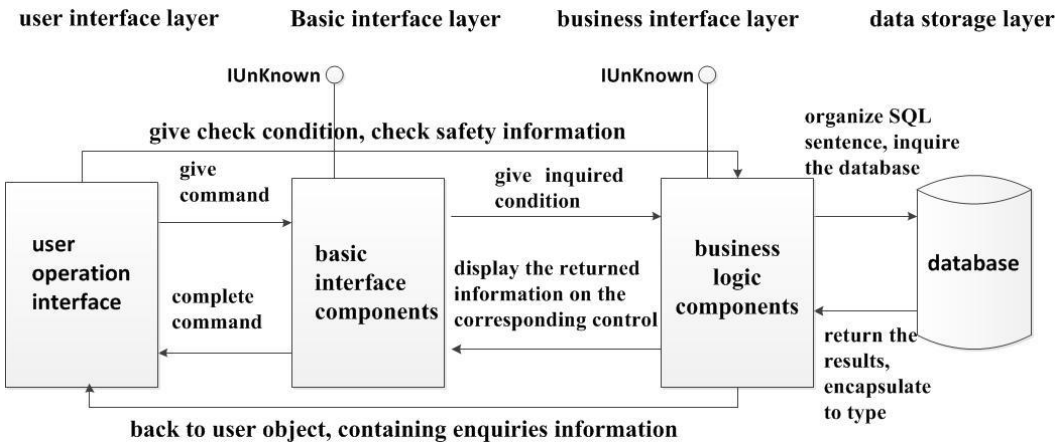

Fig.3.System structure Flow Chart.

From Fig.3, we can see that the system structure is divided into four levels: The first layer is the user interface. This layer is the user operation interface. In this level, the user can give commands, and inquire the safety information. The second layer is the basic interface. This layer is basic interface components, which likes a bridge. It links user operation interface and business interface layer. Transfer the commands given by users through basic component. The third layer is business interface layer, which is the center of the whole system structure. Orders are processed in the business logic components and then returned to the corresponding layer of the user interface layer or the basic interface layer. The fourth layer is data storage layer and all data of the system are stored here. The business logic components of the third layer can organize the SQL sentence to inquire the database. The database returns the inquired results and encapsulate to type.

5. Conclusion

Coal mine safety quality standardization management information system has a great significance to improve the coal mine safety management level and the overall level of the mines.

1) Coal mine safety quality standardization management information system has a good partition of modules. It can management safety information classily, and make the safety management in each link clear and transparent. It improves efficiency a lot than the previous file management.

2) Using fuzzy evaluation method can quickly calculate the mine's current safety quality standardization level, and it is used for managers and staff to grate, discover, and dispose the hidden mine safety trouble in time, which improves the efficiency of security management. Safety quality standardization management system can improve the mine's quality standardization success rate, reduce the frequency of the safety accidents, eventually achieve the purpose of reducing the safety management cost in coal mining enterprises.

3) This coal mine safety quality standardization management system has the advantages: low cost of development, ease of maintenance, friendly interface. These have crucial significance both in theory and practice.

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